Charting the Entrepreneurial Journey in Food Chemistry Business: Lessons Learned from Global Research Trends

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**Abstract.** Entrepreneurship in food chemistry represents a dynamic, innovative intersection where scientific inquiry meets business creation, addressing society's evolving needs and sustainable development challenges. This research aims to carry out mapping and research trends at the global level in the area of entrepreneurship journey in the food chemistry business throughout the world. The comprehensive dataset used for the research is gathered from Scopus from 1931 to 2023; this research meticulously analyzed 1,442 publication documents authored by 5,744 researchers. The methodological approach was underpinned by R Biblioshiny, facilitating advanced bibliometric analysis to dissect summary statistics, production performance, three-field plots, word clouds, trend topics, and thematic maps. This paper outlined different thematic pillars that characterize the field of food chemistry entrepreneurship, highlighting how the development of technology, considerations about sustainability, and concern for our consumer health push research direction. Emerging trends include adopting new food processing technologies, merging nanotechnology with food safety, and developing functional foods. There appears to be a new trend in these ventures where entrepreneurs are still biased towards more health-based ventures. The analysis further emphasizes entrepreneurship's critical role in translating research in food chemistry to marketable solutions that resolve the field's evolutionary trajectory challenges, providing academics, policymakers, and practitioners with insights into future opportunities and challenges. By mapping the nexus between entrepreneurship and food chemistry, this study paves the way for fostering innovation, promoting sustainable practice, and encouraging the development of enterprises that contribute to the well-being of society.

**Keywords:** Entrepreneurship, Food Chemistry, Food Technology, Bibliometric, Research Trends.

# INTRODUCTION

The growth of global entrepreneurship trends in the food chemistry business continues to rise, driven by the changing dynamics of scientific findings. As the sector navigates through evolving consumer demands and technological advances, the role of entrepreneurship in translating these complex interactions into marketable and innovative products is more critical than ever [1], [2]. Food chemistry revolves around the process and interaction of biological components of foods, including the composition of nutrition, fibers, chemistry composition, and behavior in interacting with other substances. Food chemistry has brought many breakthrough findings that have changed how we understand and manipulate food properties for better health, safety, and sustainability. These advancements include the development of fortified foods that combat nutrient deficiencies [3], the creation of novel food packaging that is biodegradable and sustainable [4], and the innovation of alternative proteins that offer sustainable solutions to traditional meat products [5], [6].

The connection between the food chemistry discipline and the business creation discipline is that the insights gained from food chemistry enable businesses to bring food-related marketable solutions to the public. Entrepreneurs can do so by tailoring products to specific health concerns and dietary restrictions, offering a competitive edge and differentiation in the crowded market [7]. Businesses rooted in the principles of food chemistry are also better equipped to navigate regulatory landscapes, ensuring compliance with food safety standards and regulations [8], [9].

Bibliometrics methodology provides the needed scientific mapping of how the research trend of food chemistry has emerged globally [10]. This methodology underscores emerging new trends, developing research themes, publication production performance, critical works that have impacted the research field, and the food chemistry business literature overview. Previous studies with similar research scope have shown the potential of how entrepreneurship can be the catalyst for increased sustainability and food safety concerns [11].

The earlier studies are a foundational entrepreneurship base in the food chemistry business research field. The previous research brings light on green food processing business techniques [12], [13], how different chemical materials can be used in food packaging for business to extend shelf-life [14], and most of the previous studies discuss the various aspects of food chemistry business by breaking down the chemical composition of industrialized food [15], [16], [17]. Another previous study discusses the public health risk in the food market and how risk-based food safety system control is necessary to be put in place in business society [11], [18]. However, little research maps the journey and studies trends in entrepreneurship in the food chemistry business at the international level. For this reason, this research aims to carry out mapping and research trends at the global level in the area of ​​entrepreneurship journey in the food chemistry business throughout the world.

# Research METHODS

This research was conducted using the bibliometric methodology. Bibliometrics has been used over the years to study statistical science mapping to decipher descriptive and network analysis of a field study [19], [20]. This study focuses on the global research trends and map of entrepreneurship in the food chemistry business. The researchers collected data from the reputable data repository Scopus, their primary database for the research [21].

**Database –**

Scopus

**Keyword search –**

1,452 documents extracted

**Inclusion criteria**

1. **Time span** –

Before 2024

**Research Documents**

**Selected for the Study –**

1,442 documents extracted

**Export of the final data for further analysis**

Bibliometrix R-package & MS Excel

**Analysis**

Summary Statistic

Production Performance

Three-Field Plots

Word Cloud

Trend Topics

Thematic Map

**FIGURE 1.** Flowchart for the Selection for Bibliometrics Analysis

The researcher gathered data by implementing strategic specific keywords for the search query. Keywords such as "entrepreneurship", "food chemistry", and similar keywords are chosen to help generate a comprehensive search query result, as seen in Figure 1. The search query used in this study was (TITLE-ABS-KEY (entrepreneur\*  OR  startup  OR  "new venture"  OR  SMEs  OR  business)  AND  TITLE-ABS-KEY (food\*  AND  chemistr\*))  AND  PUBYEAR  >  1930  AND  PUBYEAR  <  2023 which resulted into 1,442 publication documents authored by 5,744 authors. This study uses data from a year, explaining the cut-off until December 31, 2023 [22]. Data mining was restricted to yearly data so that public data could be obtained for each year's twelve months. The 1,442 document search results were then exported as CSV dataset format for data processing.

Data processing tools such as Bibliometrix-biblioshiny R-package and M.S. Excel were used to conduct comprehensive bibliometric analysis and determine its interrelations, trends, and network of the dataset [10]. The processed bibliometric data is analyzed and produced as a visualization mapping for the summary, production performance statistics, three-field plots, word cloud, trend topic, and thematic map [23]. Figure 1 shows the flowchart of bibliometric analysis and how the appropriate data was selected. These trend pattern metrics are used to understand the existing trends throughout the years in the field of food chemistry business. Understanding global research trends is fundamental for academics, policymakers, practitioners, and industry players as they show how the field's innovation has changed over time and utilize that to their advantage [24]. The role of entrepreneurship research in the food chemistry business opens new opportunities for marketable solutions, sustainability challenges, and fulfilling consumer demands [25].

# RESULTS AND DISCUSSION

**Summary Statistics**

This section of the study discusses the bibliometric analysis summary for the entrepreneurship journey in the food chemistry business, as seen in Table 1. The results show that the 1,442 recorded documents were written by 5,744 authors from 1931 to 2023. These documents originate from 348 publication sources with a total of 60,103 citations, and each document's citations average 40.15. The number of single-authored documents is 116, while the average number of authors per co-authored document is 4.38.

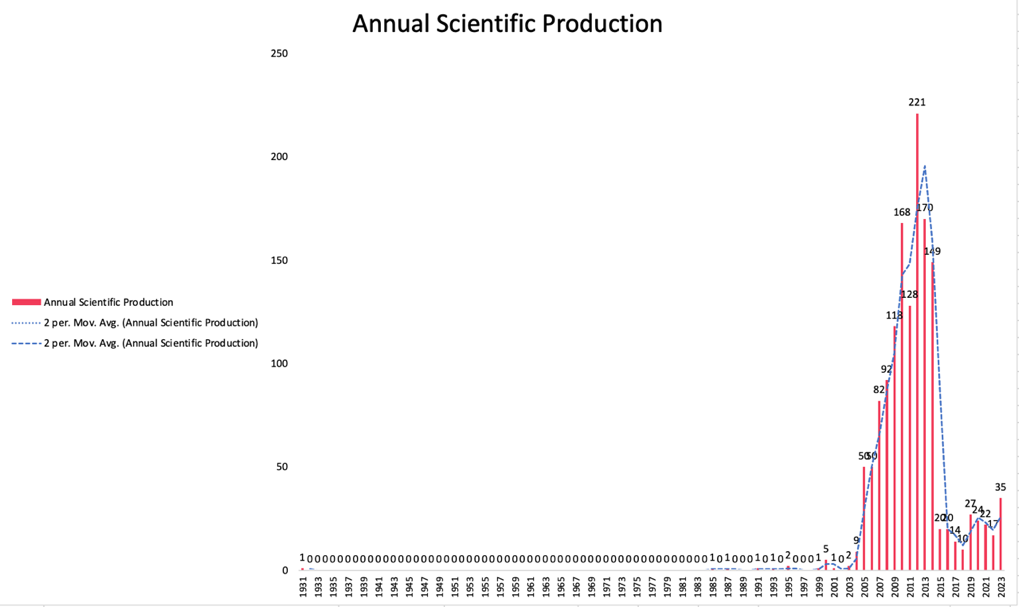
**TABLE 1.** Summary Statistics of Entrepreneurship in Food Chemistry Business

|  |  |  |  |
| --- | --- | --- | --- |
| **Description** | **Results** | **Description** | **Results** |
| MAIN INFORMATION |  | DOCUMENT TYPES |  |
| Timespan | 1931:2023 | Article | 1,200 |
| Sources | 348 | Book | 22 |
| Document | 1,442 | Book Chapter | 36 |
| Annual Growth Rate % | 3.94 | Conference Paper | 47 |
| Document Average Age | 12.5 | Conference Review | 1 |
| Average Citation per Doc | 40.15 | Editorial | 1 |
| References | 60,103 | Erratum | 1 |
|  |  | Note | 7 |
| AUTHORS |  | Retracted | 1 |
| Authors | 5,744 | Review | 121 |
| Authors of single-authored documents | 108 | Short Survey | 5 |
|  |  | DOCUMENT CONTENT |  |
| AUTHORS COLLABORATION |  | Keywords Plus (ID) | 13,655 |
| Single-authored Docs | 116 | Authors Keywords (DE) | 5,071 |
| Co-Authors per Doc | 4.38 |  |  |
| International co-authorships % | 22.88 |  |  |

The entrepreneurial journey in the food chemistry business has evolved due to the change in the generation's interest in pushing for more breakthrough innovations caused by technological advancements, regulatory changes, and shifts in consumer preferences [12], [14], [25]. Understanding the challenges of the food chemistry business involves examining trends and thematic elements that highlight the industry's dynamic nature and response to these factors. These insights are crucial for strategizing future innovation and policies in the food chemistry industry [25].

**Production Performance**

The production performance of entrepreneurial journey research in the food chemistry business has shown that a fair amount of interest was taken in this field of study. The first document related to the entrepreneurship journey in the food chemistry business was published in 1931. After the first published document, the scientific contribution remained relatively low, reflecting the nascent state of the food chemistry business before the 2000s came in. A sharp increase in scientific document production occurred after the year 2000, signaling a growing awareness of the importance of food chemistry. This surge may be attributed to the increased global focus on food safety, nutritional science, and environmental concerns. The number of publications peaked in 2011 with 221 documents and a 42.08% increase in new documents compared to the previous year (128 documents).



**FIGURE 2.** Annual Scientific Production of Food Chemistry Business

Although the production amount has slowed in recent years, data from 2022 and 2023 show an upward trajectory, as seen in Figure 2, hinting at renewed interest in the field. The predicted renewed interest is driven by emerging trends in food sustainability and the pursuit of innovative food products [11]. These fluctuations underscore the evolving landscape of food chemistry research, allowing entrepreneurs to anticipate market needs and align their products with scientific findings. Researchers and business innovators can benefit from understanding these trends and identifying emerging trends that could inspire new sustainable innovations stemming from food chemistry research [8].

**The Correlation between Keywords, Highly Cited Documents and Authors**

The three-field plot in Figure 3 provides a comprehensive visual summary of the correlation between keywords (DE), highly cited documents (CR), and authors (3AU) of the food chemistry business from 1931 to 2023 from the Scopus database. The chart reveals the influential articles driving current research and their relationship with critical authors in the food chemistry industry. Highly cited documents are referred to CR in the chart, with articles like "Official Method of Analysis "(1995) and "Official Method of Analysis "(1990) serving as foundational text that numerous researchers rely upon. Authors such as Bhattacharyya, Wanapat M, Fan S, and Liu Y are prominent for their work, contributing to vital keyword areas like digestibility, food safety, and residue.

A screenshot of a computer

Description automatically generated

**FIGURE 3.** Three-Field Plots of Food Chemistry Business

A close-up of words

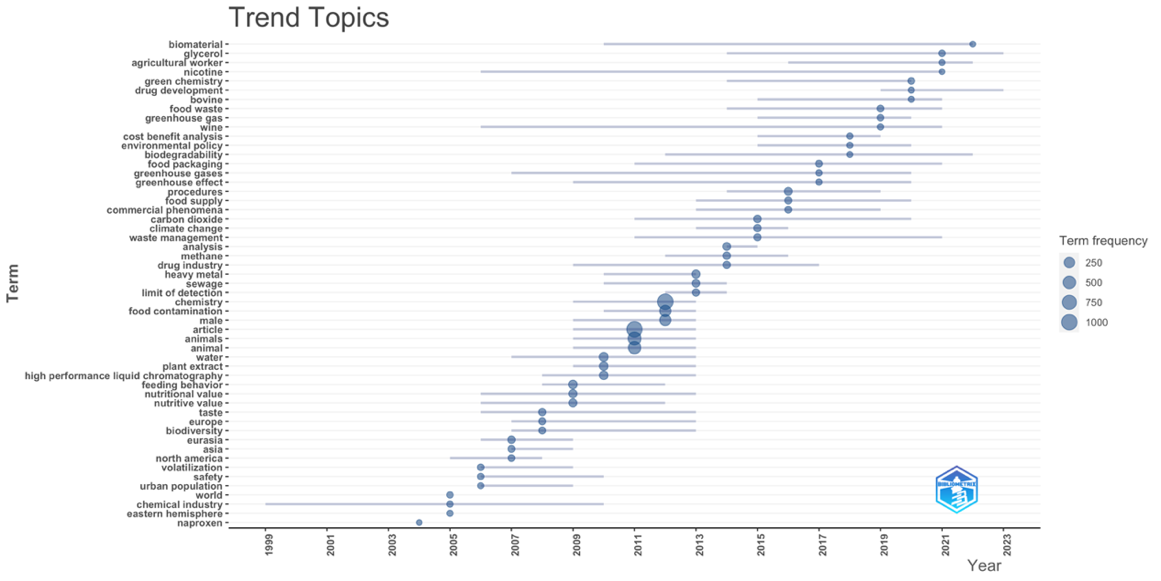
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**FIGURE 4.** Word Cloud of Food Chemistry Business

The keyword that was common in the three-field plot dataset in Figure 3 was "distillation", "residue", "soil", and "food safety". Figure 4 also displays the keywords most affiliated with entrepreneurial documents in the food chemistry research fields through a word cloud analysis. The word cloud shows that the keywords that stood out are "chemistry", "animals", "food contamination", "article", and "metabolism", indicating that foundational chemical principles are the core of many research documents [8], [26]. The plot underscores the interdisciplinary nature of food chemistry research and the varied global focus areas. This provides entrepreneurs with a clear framework for identifying key market opportunities and leveraging scientific research for business innovation [10].

**Trend Topics**

Figure 5 presents a detailed timeline of key research themes highlighting the entrepreneurship evolving scene of food chemistry research and business. This figure plots the frequency of trend topic terms, focusing on significant themes and their periods of prominence. The horizontal axis denotes the years, while the vertical axis represents the frequency of trending terms or phrases specific to the food chemistry business. The scatter plot dot indicates the frequency of each trending term; the more significant the dot, the signifying a more substantial presence in the field



**FIGURE 5.** Trend Topic of Entrepreneurship in Food Chemistry Business

As seen in Figure 5, the terms "chemistry" and "animals" were the most prominent from 2011 to 2013, lasting briefly and hinting that much interest was taken on these topics. Both terms with the most prominent dots in the graph suggest that the foundational concepts were surrounded by significant research activity during this period. This aligns with the global increase in attention towards integrating food chemistry in the context of animal-derived food products [27]. Furthermore, the graph highlights the shift in research focus, with newer terms such as "biomaterial" and "glycerol" appearing recently. There was a shift with the newer trends indicating the broadening scope of research interest in food chemistry, resulting in more innovations and groundbreaking findings. Trend topics ultimately help researchers understand which trends are relevant in the past years and predict the upcoming trends through recurring patterns in the food chemistry business.

**Thematic Map**

The thematic map categorizes various research topics within entrepreneurship in the food chemistry business based on their developmental degree and relevance, as observed in global trends [19]. The horizontal axis represents each theme's relevance degree (centrality), indicating how central or significant a theme is within the field. The vertical axis measures the developmental degree (density), suggesting the extent to which each theme is developed or elaborated in the literature. The thematic map is divided into four quadrants: niche themes, motor themes, emerging or declining themes, and basic themes as seen in Figure 6 [10].

A diagram with text on it

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**FIGURE 6.** Thematic Map of Food Chemistry Business

Niche themes in the upper left quadrant are the detailed and specific research subfields with a high development degree of a specialized area but low relevance and implication to the general research field [10]. Themes such as "food contamination", "environmental monitoring", and "physical chemistry" are seen in this quadrant, presenting the more focused but narrow scope of research in the food chemistry field. Motor themes in the upper right quadrant are pivotal and thoroughly researched, often as innovative and breakthrough findings for other new research documents [28]. Emerging or declining themes in the lower left quadrant are the areas of research that are neither high in development nor relevance, meaning the loss or lack of extensive research in the theme area. Basic themes, in the lower right quadrant, are the fundamental but underdeveloped research area, as they are high in relevance but low in development. Themes such as "article", "human", and "humans" show the fundamental and general concepts in the research area of food chemistry. The largest cluster of themes sits right in the middle with "chemistry", "animals", and "animal", showing consistent relevance yet still serving as the general overall themes in the food chemistry field.

# Future research

This study presents insights into the literature landscape of entrepreneurship in the food chemistry business and how far along the field has evolved into its current state. From the bibliometrics perspective, this study has only scratched the surface of the research field, and the gaps that have not been addressed may lead to substantial advancements. Future research could utilize other databases to gain insights through datasets such as Web of Science (WoS), Lens.org, and PubMed. Future research directions could use different types of methodology to address different perspectives on the topic and gain a more profound understanding of the research domain through a literature review or meta-analysis. The synthesis of two distinct disciplinary fields encourages a multidisciplinary research approach, leading to discoveries that could revolutionize food production, safety, and sustainability. Gaps that have not been delved into in this research include developing new food products that cater to changing consumer preferences, alternative proteins, biodegradable packaging, adopting new food processing technologies, merging nanotechnology with food safety, producing functional foods, and much more. The potential of entrepreneurship in food chemistry has opened more doors for breakthrough innovations in making food chemistry more accessible to the public through marketable food products.

# CONCLUSIONS

This article underlines the lessons we gained through the global research trend of the entrepreneurship journey in the food chemistry business research field. The evolution of the food chemistry business research domain through trends throughout 1931-2023. One thousand four hundred forty-two documents related to entrepreneurship and food chemistry business were compiled from Scopus for the dataset used in this study. The compiled data was then processed using Bibliometrix-biblioshiny R-Package and M.S. Excel for further analysis. The production performance indicates that the field initially attracted significant interest, although it experienced a decline over the past five years. However, recent trends suggest a resurgence of interest, as evidenced by a noticeable uptick in activity in the most recent years. The research mapping using a three-field map reveals the collaborative focus of entrepreneurship and food chemistry business through the connections of highly cited documents, keywords, and authors. Word cloud, trend topic, and thematic map showcase the most relevant keywords in this research domain are "chemistry", "article", "animals", and "metabolism", with the keyword sitting right in the middle of the four quadrants of the thematic map, showing the consistent relevance yet still serving as the general overall themes in the food chemistry field.

This article emphasizes entrepreneurship's critical role in translating research in food chemistry to marketable solutions that resolve the field's evolutionary trajectory challenges, providing academics, policymakers, and practitioners with insights into future opportunities and challenges. Through an analysis of global research trends, this study reveals how entrepreneurial endeavors have catalyzed innovations, particularly in sustainable food solutions. Furthermore, the analysis highlights the importance of cross-disciplinary collaboration in fostering food chemistry and entrepreneurship advancements. The lessons learned from examining global research trends underscore the necessity for continued investment in research and development within the food chemistry sector.

There are limitations as this study only covered bibliometrics methods and used Scopus as its primary database. This article only discusses the overview of the bibliometrics analysis of entrepreneurship in the food chemistry business and the global research trends.

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